इंटरनेट मानक

Disclosure to Promote the Right To Information

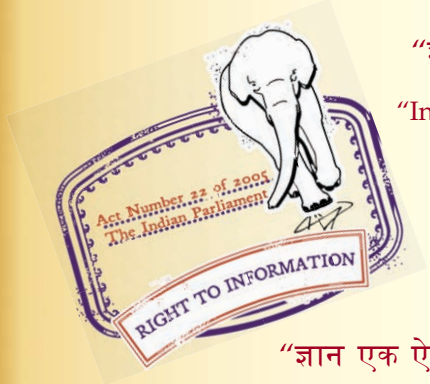
Whereas the Parliament of India has set out to provide a practical regime of right to information for citizens to secure access to information under the control of public authorities, in order to promote transparency and accountability in the working of every public authority, and whereas the attached publication of the Bureau of Indian Standards is of particular interest to the public, particularly disadvantaged communities and those engaged in the pursuit of education and knowledge, the attached public safety standard is made available to promote the timely dissemination of this information in an accurate manner to the public.

"जानने का अधिकार, जीने का अधिकार"
Mazdoor Kisan Shakti Sangathan
"The Right to Information, The Right to Live"

"पुराने को छोड नये के तरफ"
Jawaharlal Nehru
"Step Out From the Old to the New"

IS 10336 (1982): Guidelines for Preparation of Completion Reports of Multipurpose River Valley Projects [WRD 6: Water Resources Planning, Management and Evaluation]

"ज्ञान से एक नये भारत का निर्माण"
Satyanarayan Gangaram Pitroda
"Invent a New India Using Knowledge"





"ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है"
Bhartṛhari—Nītiśatakam
"Knowledge is such a treasure which cannot be stolen"

BLANK PAGE





PROTECTED BY COPYRIGHT

IS : 10336 - 1982

(Reaffirmed 2005)

Indian Standard

GUIDELINES FOR PREPARATION OF COMPLETION REPORTS OF MULTIPURPOSE RIVER VALLEY PROJECTS

UDC 627·8 (083·93) : 651·78

© Copyright 1983

INDIAN STANDARDS INSTITUTION
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Gr 12

September 1983

Indian Standard

GUIDELINES FOR PREPARATION OF COMPLETION REPORTS OF MULTIPURPOSE RIVER VALLEY PROJECTS

River Valley Planning, Project Reports, Progress and Completion Reports Sectional Committee, BDC 50

Chairman

SHRI K. R. MEHNDIRATTA

N-13, Tara Apartments, Kalkaji, New Delhi-110019

Members	*Representing*
BRIG V. N. AGRAWAL	Engineer-in-Chief's Branch, Army Headquarters, New Delhi
SHRI D. S. MANDALIKA (*Alternate*)	
CHIEF (IRRIGATION)	Planning Commission, New Delhi
CHIEF ENGINEER	Himachal Pradesh State Electricity Board, Simla
CHIEF ENGINEER	Irrigation and Power Department, Government of Andhra Pradesh, Hyderabad
SUPERINTENDING ENGINEER (*Alternate*)	
CHIEF ENGINEER	Public Works and Electricity Department, Government of Karnataka, Bangalore
DIRECTOR (WRDO) (*Alternate*)	
CHIEF ENGINEER (IRRIGATION)	Public Works Department, Government of Rajasthan, Jaipur
CHIEF ENGINEER (IRRIGATION)	Public Works Department, Government of Tamil Nadu, Madras
SUPERINTENDING ENGINEER (PARAMBIKULAM ALIYAR PROJECT) (*Alternate*)	
CHIEF ENGINEER (PROJECT)	Irrigation Works, Government of Punjab, Chandigarh
SUPERINTENDING ENGINEER (PROJECT) (*Alternate*)	
CHIEF ENGINEER (WORKS)	Beas Sutlaj Link Project, Sunder Nagar (H P)
SHRI G. P. AGGARWAL (*Alternate* I)	
SHRI S. L. BHATIA (*Alternate* II)	
DIRECTOR GENERAL	Geological Survey of India, Calcutta
SHRI K. N. SRIVASTAVA (*Alternate*)	
DIRECTOR (HTD-I)	Central Electricity Authority, New Delhi
DIRECTOR (PLANNING AND DESIGN)	Bhakra Beas Management Board (Power Link), Patiala

(*Continued on page* 2)

© *Copyright* 1983

INDIAN STANDARDS INSTITUTION

This publication is protected under the *Indian Copyright Act* (XIV of 1957) and reproduction in whole or in part by any means except with written permission of the publisher shall be deemed to be an infringement of copyright under the said Act.

(*Continued from page* 1)

Members	*Representing*
DIRECTOR (R & C)	Central Water Commission, New Delhi
DEPUTY DIRECTOR (R & C) (*Alternate*)	
SHRI R. L. GUPTA	Irrigation Department, Government of Madhya Pradesh, Bhopal
SHRI L. M. SARKAR (*Alternate*)	
MEMBER (GENERATION)	Uttar Pradesh State Electricity Board, Lucknow
ADDITIONAL CHIEF ENGINEER (PLANNING) (*Alternate*)	
SHRI S. R. SANGAL	Irrigation Department, Government of Uttar Pradesh, Lucknow
SECRETARY	Central Board of Irrigation and Power, New Delhi
JOINT SECRETARY (*Alternate*)	
SUPERINTENDING ENGINEER	Irrigation Project Circle, Irrigation Department, Government of Maharashtra, Nasik
SHRI G. RAMAN Director (Civ Engg)	Director General, ISI (*Ex-officio Member*)

Secretary

SHRI HEMANT KUMAR

Assistant Director (Civ Engg), ISI

CONTENTS

		Page
0.	FOREWORD	4
1.	SCOPE	5
2.	DESIGN, MODEL STUDIES AND CONSTRUCTION FEATURES ...	5
	2.1 General Description	6
	2.2 Design Features and Model Studies of Dam and Apurtenant Works	8
	2.3 Construction Features of Dam and Apurtenant Works	18
	2.4 Design and Construction of Power Plant	38
	2.5 Design and layout of Barrages, weirs and Head Works	44
	2.6 Design and Layout of Canal Distributors for Irrigation, Navigation and Water Supply	48
	2.6.1 Irrigation	48
	2.6.2 Design of Construction of Navigation Canal System	54
	2.6.3 Design and Construction of Canal System for Water Supply to Towns, Industries and Thermal Power Stations	58
	2.7 Design and Layout of Power Transmission and Distribution System	64
3.	OPERATION, MAINTENANCE AND OBSERVATION	66
	3.1 Reservoir	67
	3.2 Dam Barrage, Weir	70
	3.3 Power Plant Civil Structures, Piping System and Mechanical Accessories	72
	3.4 Canal System	74
	3.5 Power Plant, Switch Yard etc	74
	3.6 Flood Embankment	76
4.	LAND ACQUISITION AND REHABILITATION	78
	4.1 Land Acquisition and Rehabilitation	78
5.	ALBUM OF DRAWINGS	79
6.	TECHNICAL REPORTS	80
7.	GET UP OF THE PUBLICATION	80

Indian Standard

GUIDELINES FOR PREPARATION OF COMPLETION REPORTS OF MULTIPURPOSE RIVER VALLEY PROJECTS

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 27 September 1982, after the draft finalized by the River Valley Planning, Project Reports and Progress Reports Sectional Committee had been approved by the Civil Engineering Division Council.

0.2 To utilize the valuable experience gained in a project by others, it is essential to publish completion reports of the multipurpose river valley projects. Such publications would also serve as an extremely helpful record for the maintenance of various components of the projects after completion.

0.3 Different methods, as detailed below, have been followed in USA for writing the history of the projects:

a) In case of Hoover Dam, number of volumes were published, each dealing with specific subjects, such as trial load analysis, spillway design, diversion and outlet works, power plant, design and construction.

b) In case of Tannesse Valley Authority, the information recorded was brief and contained in one volume for each project. In this volume both the design and construction features were recorded side by side and only broad information had been included. Detailed design and construction features were not recorded by Tannesse Valley Authority in the report of Hoover Dam.

c) Another method is to have completion reports which include the drawings and specifications actually followed for the completion of the dam, power plant and other features. Such books are often published by United States Bureau of Reclamation, as for example in the case of Hungary Horse and other projects. Such completion reports neither give details of the difficulties encountered in construction or design nor include any details of actual construction or design problems. These completion reports are more or less the revised editions of contract drawings, and specifications, with which the tenders are invited and the work proposed to be done and incorporate all the changes that take place during actual execution of the work.

0.4 In our country also completion reports have been prepared for Bhakra, Rihand, Kunda and Hirakud Projects and a reference may be made to them while preparing the completion reports of projects.

0.5. Each project has its own specialities and peculiarities, therefore, an attempt has been made in this standard to cover most of the interconnected aspects with a view to derive maximum utility from the completion reports, although some of the aspects covered would not be applicable in specific cases.

0.6 Taking into consideration the importance of completion reports, it is advised that a separate set-up in each project should be established for preparing completion reports (for example a circle in important projects).

0.7 In the formulation of this standard, considerable assistance has been derived from Bhakra Management Board and is based on the 'Guidelines for preparation of Bhakra Nangal publications'.

1. SCOPE

1.1 This standard only enlists various aspects to be covered in a typical completion report of a project. The project authorities may change the extent of coverage of different aspects of the report depending on importance and magnitude of the project.

1.2 The guide may be divided into the following features:

a) Design, model studies and construction features;
b) Operation, maintenance and observation;
c) Land acquisition and rehabilitation;
d) Album of key drawings;
e) Technical reports; and
f) Get up of the publications.

1.2.1 Each feature may be further subdivided into a number of parts and should have a table of contents.

2. DESIGN, MODEL STUDIES AND CONSTRUCTION FEATURES

2.0 This should contain details of the actual design, construction features and model studies besides information on the difficulties encountered in the construction or design together with the methods adopted for surmounting them. This may be prepared in the following parts:

a) General description,
b) Design features and model studies of dam and appurtenant works,

c) Construction features of dam and apurtenant works,

d) Design and construction of power plant,

e) Design and layout of barrages, weirs and head works,

f) Design and layout of canals and distributaries for irrigation, navigation, water supply, etc, and

g) Design and layout of power transmission and distribution system.

These parts may be further subdivided into chapters and items as detailed in **2.1** to **2.7** and may contain any other aspects peculiar to the project under consideration.

2.1 General Description — This should be compiled after all others are completed.

Chapter	*Title*	*Clause*	*Description*
1	Cost	1	Comparative statements showing general and detailed abstracts of costs of the various units in accordance with original estimate and actual expenditure. The abstract of costs shall be given under the minor head classification and detailed heads as prescribed in IS : 4877-1968*.
		2	A comparative statement showing the variations in the estimated and actual quantities of important items of works and rates of each item and reason thereof.
		3	An analysis of the reasons for increase in cost over the original sanctioned estimate and the amount of increase due to: a) Rise in prices of labour and materials, b) Rise due to change in scope, c) Rise due to inadequate provisions in the original estimate, d) Rise due to inadequate investigations when preparing the original estimate,

*Guide for preparation of estimate for river valley projects.

Chapter	*Title*	*Clause*	*Description*
			e) Rise due to change in design and additional requirements, and
			f) Rise due to other causes (which should be identified and discussed separately as far as possible).
		4	A detailed note indicating the works done through contractors or department.
		5	Extent to which mechanized construction was done.
		6	Basic wages of workers and amenities provided to them both by the contractors and the department.
		7	Organizational set up of the project for investigations, design and construction.
		8	Statement showing year-wise total expenditure and manpower deployed.
		9	Sources of construction materials and their distances of work from the source of supply or manufacture.
		10	Basic rates of steel, cement, petrol, oil, lubricants and explosives.
		11	Statement of materials supplied to the contractors departmentally and how the issue rate were arrived at.
		12	Extent of excavated material used in the construction work.
		13	Public facilities, such as water supply and electric power for construction.
		14	Analysis of unit rates of important items in accordance with actual experience on the project.

Chapter	*Title*	*Clause*	*Description*
		15	Extent to which machinery is actually used in the construction of various items of works as a percentage of capital cost of tools and plants.
		16	Bar chart showing construction programme giving item-wise, quantity-wise and year-wise targets of construction and actual achievements.
		17	The cost of distributaries, minors, water courses per hectare of culturable command area with a typical plan showing the layout covering about 10 percent of the command area.
		18	Procurement of labour for the project.
		19	Details of the machinery procured for the project, its source of purchase and capital cost. Extent to which machinery was hired by the contractors.
		20	Price adjustments in contracts and formula used for payment of escalation on account of labour, materials, petrol, oil and lubricants.
		21	Disputes encountered during the progress of work due to non-settlement of rates and their settlement.

2.2 Design Features and Model Studies of Dam and Appurtenant Works — This part may have the following chapters and clauses. Each item under this part should deal with design assumptions and other details.

Chapter	*Title*	*Clause*	*Description*
1	Introduction	1	General.
		2	Geography, topography and regional geology.
		3	Earthquake hazards, seismic vulnerability and seismic considerations.

Chapter	*Title*	*Clause*	*Description*
		4	River(s) hydrology.
		5	History and origin of the proposal, developments leading to various designs.
		6	Reservoir(s).
		7	Scope, cost and benefit of the project.
		8	Basic data.
		9	Agency for design.
II	Design	1	Introduction.
		2	Early schemes with various alternatives considered.
		3	Design features as originally envisaged before construction.
		4	Final design as adopted.
		5	Location of the dam and appurtenant works.
III	Diversion works	1	General : a) Diversion plan, b) Sequence of diversion operation, and c) Design floods.
		2	Diversion tunnels and channels: a) General, b) Design of channels/tunnels including lining, portals, adits, closure plug, etc, and c) Closure schedule.
		3	Coffer dam: a) Layout, b) Height of coffer dam, and c) Design of section.
IV	Dam	1	Geology a) Introduction,

Chapter	*Title*	*Clause*	*Description*
			b) Foundation geology, c) Exploration of foundation and abutments: i) Exploratory drifts; ii) Exploratory drilling, field and laboratory tests to estimate rock and soil properties; and iii) Other methods (*see* Appendices A, B and C).
		2	Choice of type of dam and design analysis: a) Materials of construction, b) Type of dam and section, and c) Analysis: i) Arch analysis; ii) Wedge/slip circle method of analysis; and iii) Trial load method of analysis.
		3	Foundations a) Treatment of foundations: i) Heal/toe/cutoff trenches ii) Consolidation grouting iii) Curtain grouting b) Foundation drainage
		4	Concrete dams a) Block and monolith plan, keyways b) Strength requirement and mix design c) Temperature control d) Joint and joint grouting e) Face work f) Instruments in dam

Chapter	*Title*	*Clause*	*Description*
		5	Earth and rockfill dams
			a) Cut off trenches, key trenches, drilling and grouting
			b) Filter media
			c) Rock toe and toe drain
			d) Semipervious, impervious and pervious fill
			e) Front and rear slope protection works
			f) Bleeder relief wells at rear of dam
			g) Model and lab studies
			h) Treatment at junction of (hillock) abutment and earthen dam
		6	Galleries and shafts
			a) Foundation galleries
			b) Inspection galleries
			c) Grouting and drainage tunnels
			d) Galleries to power plants
			e) Elevator shaft
			f) Hoist shaft
			g) Gallery ventilation
			h) Gallery reinforcement
		7	Drainage, water supply, sanitation and other facilities in dam
			a) Drainage
			b) Water supply in dam
			c) Sanitary system in dam
			d) Air conditioning and dehumidification
			e) Telecommunication system
		8	Electrical features
			a) General
			b) Auxiliary power system

Chapter	*Title*	*Clause*	*Description*
			c) Control and signalling system
			d) Lighting system
			e) Grounding system
		9	Mechanical features
			a) Cranes and Hoists:
			i) Capacity
			ii) Loading
			iii) Stresses
			b) Hoist shaft, draw-bridge and transfer car
			c) Elevators
		10	Approaches and parking areas
			a) Parking areas
			b) Rail link
			c) Road link
		11	Architectural treatment
			a) Curve in the body of the dam
			b) Parapets
			c) Elevator and hoist tower
			d) Visitors balcony, gallery and cantilever porch at entrance to visitors gallery
			e) Spillway bridge downstream balcony
			f) Vehicular traffic
			g) Floor finishes
			h) Landscaping of dam
			j) Illumination
			Appendices
			A Geology and investigation of the dam site
			B Statement showing analysis of rates per metre of exploratory drilling with size of bit used.

Chapter	*Title*	*Clause*	*Description*
			C Statement showing rate of construction of various materials, per 25 m depths of exploratory drilling at dam site.
V	Spillway, spillway gates and bridges	1	General
		2	Hydraulic features
			a) Spillway crest and profile
			b) Energy dissipation and apron
		3	Structural Design Features
			a) Spillway crest
			b) Drainage of apron slab
			c) Training walls
			i) General description
			ii) Joints
			iii) Keyways
			iv) Structural design
			v) Drainage behind the training walls
			d) Spillway bridge and spillway piers
		4	Gates and hoists
			a) Gate assembly and anchorages
			b) Hoist
VI	Outlets from the dam	1	General
		2	Number and arrangement of outlets
		3	Hydraulic features
		4	Intake shafts
		5	Structural features
			a) Liner
			b) Reinforcement
		6	Air demand of outlets
		7	Trashrack and trashrack structures

Chapter	*Title*	*Clause*	*Description*
		8	Drainage and fill pipes for conduits upstream of gates
		9	Gates, hoists and controls
			a) Description
			b) Design data
			c) Design assumptions
			d) Design stresses and pressures
			e) Factors of safety
		10	Gantry
			a) General
			b) Design load and assumptions
			c) Normal allowable stresses
		11	Gate guides and embedded parts
		12	Slot covers
VII	Tunnels	1	Design discharge for maximum, minimum and rated output
		2	Length of tunnel
		3	Section, shape and gradient
		4	Value of rugosity coefficient and permissible velocity
		5	Stability of portals
		6	Rock cover and rock load supports (*see* Appendix A)
		7	External rock pressures
		8	Design head, head loss in tunnels for maximum, minimum and rated output
		9	Temperature and gases in tunnels
		10	Ground water condition
		11	Concrete lining
		12	Grouting and drainage behind lining

Chapter	*Title*	*Clause*	*Description*
		13	Addits, shafts and plugging arrangement
		14	Communication
		15	Design of intakes and outlets
			Appendix
			A Tests to estimate rock and soil properties
VIII	Surge shaft	1	Introduction
		2	Necessity
		3	Location
			a) Feasibility from geological consideration
			b) Comparative cost
		4	Selection of type
		5	Loading conditions
			a) Up surge
			b) Down surge
		6	Hydraulic design
			a) Diameter of surge tank
			b) Height of surge tank
			c) Hydraulic stability
		7	Structural design
			a) Rock cover
			b) Geology
			c) Seismic effect
			d) Surge shaft lining
		8	Grouting
			a) Contact grouting
			b) Consolidation grouting
			c) Anchorage
		9	Drainage

Chapter	*Title*	*Clause*	*Description*
		10	Model test a) Hydraulic b) Structural
IX	Forebay	1	Geological information which finally decides the location and overall designing features of the forebay
		2	Design criteria for fixing the normal reservoir level and minimum draw down levels, live storage capacity, etc
		3	Peaking capabilities corresponding to the live storage capacity
		4	Design criteria for the penstock intake gates in the forebay including trashrack details and arrangements for periodic cleaning of the same
		5	Operating time of the penstock head gates in the forebay
		6	Details of byepass structures provided in the forebay
		7	Design criteria for determining the discharge capacity of the byepass
		8	Type and constructional features of byepass gates
		9	Details of spilling chutes including arrangements for energy dissipation
X	Valve House (for power)	1	Design considerations determining the location and overall arrangements of the valve house
		2	Details of expansion joints upstream and downstream of the inlet valves with the penstocks
		3	Detailed layouts of the main valve and other auxiliary equipment in the valve house

Chapter	*Title*	*Clause*	*Description*
		4	Type of the valve including operating mechanism details for opening/ closing
		5	Maximum and rated heads as well as the discharge capacity of the main valves
		6	Friction losses in the valve for rated discharge conditions
		7	Opening and closing time for which the valves are designed
		8	Details of the main and repair seals of the valves
		9	Means provided for maintenance of the valve seals and for any other maintenance work
		10	Details of valve house crane, other plant and machinery
XI	Penstocks and head gates	1	General and choice of size
		2	Layout and alignment
		3	Anchor blocks and saddle supports
		4	Reinforcement around penstock openings
		5	Steel for penstock
		6	Intake transition and branching
		7	Penstock crossing of longitudinal contraction joints
		8	Concreting, contact and consolidation grouting
		9	Expansion coupling
		10	Trashrack structure
		11	Drainage behind penstocks
		12	Blockouts

Chapter	*Title*	*Clause*	*Description*
		13	Mechanical features
			a) Temporary steel bulkheads
			b) Head gates and gate frames
			c) Gate hoists
			d) Penstock stoplogs and lifting beam
			e) Trashracks
			f) Pit and bulkhead drainage
			g) Air vent
			h) Fill and drain pipes
			j) Piezometers

2.3 Construction Features of Dam and Appurtenant Works — This part may have the following chapters and clauses:

Chapter	*Title*	*Clause*	*Description*
I	Introduction	1	General
		2	Main features of the project
		3	Construction plant design
		4	Construction and inspection agencies
		5	Major construction details
		6	Cost data (*see* Appendix A)
		7	Chronology
			Appendix
			A Detailed account of capital expenditure on dam
II	Agency of construction	1	Organization
		2	Employment agency and procedures
			Appendix
			A Organizational set up
III	Agency for inspection		Organization
IV	Communication to site of work	1	Access roads
		2	Access railway

Chapter	*Title*	*Clause*	*Description*
		3	Bridges and tunnels
		4	Post and telecommunication
V	Accommodation and service facilities for staff, workers and visitors	1	General
		2	Accommodation
		3	Service facilities like hospitals, schools and recreation arrangements, etc (*See* Appendix A & B)
		4	Public relations agency and tourist facilities
			Appendices
			A Statement showing types and numbers of various quarters constructed
			B Statement showing plinth area and unit rates of various buildings
VI	Diversion of river during construction	1	Diversion works
		2	Diversion channels/tunnels
		3	Main diversion coffer dams
		4	De-watering of working area for construction
			Appendices
			A Detail of machinery used in the diversion works with early working hours of machinery for diversion works
			B Details of explosives used in diversion works
			C Quantity and rate for excavation per cubic metre
			D Laboratory design of concrete mix

Chapter	*Title*	*Clause*	*Description*
			E Quantity and rate for cubic metre of concrete
			F Quantity and cost of reinforcement
			G Data and abstract of cost of diversion works
VII	Closure of diversion system and early storage	1	Storage against partially completed dam
		2	Closure of diversion system
VIII	Excavation for dam	1	Dewatering
		2	Excavation of foundation and abutments of the dam
		3	Removal of muck and hydraulic sluicing
		4	Excavation of fault and shear zones in the foundation of the dam
			Appendices
			A Statement showing analysis of rates per cubic metre of excavation at various elevations in the foundations and abutments of the dam
			B Statement showing material actually consumed for the work of excavation of various elevations in the dam and spillway apron
			C Dam and appurtenant works, monthwise progress of quantities excavated
			D Details of dewatering arrangement and rate analysis
IX	Excavation of head race tunnels	1	Approach and excavation of adits and shafts
		2	Drilling, blasting and mucking

Chapter	*Title*	*Clause*	*Description*
		3	Erection of supports and initial concreting
		4	Ventilation
		5	Drainage
		6	Lighting arrangement
		7	Transportation of material and labour
		8	Concreting
		9	Equipment used
		10	Communication
X	Excavation of other tunnels and miscellaneous works	1	Grouting and drainage tunnel in the dam
		2	Highway and railr/road tunnels
		3	Minor tunnels
		4	Excavation for plant area
		5	Dredging of river

Appendices

A Statement showing analysis of rate per cubic metre of excavation for various grouting and drainage tunnels, highway tunnels and rail/road tunnels

B Statement showing materials used for the excavation of various highway and rail/road tunnels

C Statement showing analysis of rate per cubic metre of excavation for various minor tunnels and plant area

D Statement showing materials used on the work of excavation of various minor tunnels and plant area

Chapter	*Title*	*Clause*	*Description*
XI	Excavation of surge shaft	1	Surge shaft excavation
		2	Rock supports and treatment
		3	Reinforcement
		4	Concreting of surge shafts and its sequence
		5	Contact grouting
		6	Consolidation grouting
		7	Drainage galleries around surge shafts
		8	Drainage holes
		9	Concreting of surge shaft risers
		10	Mechanical installations a) Steel liners fabrication b) Steel liners installation c) Steel liners painting
XII	Excavation of power house and auxiliary works	1	Power house
		2	Penstock tunnels
		3	Tail race
		4	Dewatering arrangement
		5	Switch yards
			Appendices A Statement showing analysis of rates per cubic metre of excavation for power plant, switch yards of penstock tunnels B Statement showing material used for the work of excavation of power plant and switch yards of penstock tunnels C Statement showing out-turn per dipper meter of various shovels employed for excavation of power plant

Chapter	*Title*	*Clause*	*Description*
XIII	Foundation treatment and drainage arrangement for dam, power house, and other civil structures	1	Drilling and consolidation grouting
		2	Drilling and curtain grouting
			a) Intermediate pressure grouting curtain
			b) High pressure grouting curtain
		3	Treatment of weak rock seam
		4	Rock pinning
		5	Foundation, drainage and other treatment for the dam, power house and other civil structures
		6	Heal/toe/cutoff trenches
			a) Strata met with in different reaches
			b) Comparison of geologist report and strata actually met with
			c) Nature of cutoff provided
			i) Positive cutoff
			ii) Partial cutoff
			d) Filling up of the trench
			e) Clay blanket
			Appendices
			A Field tests carried out on foundation rocks
			B Location of holes, grout intakes and grout pressures
			C Grouting plant and equipment
			D Typical unit rates of drilling washing and grouting for consolidation grouting of rock
			E Statement showing quantity, consumption of material and unit rate of cost of grout curtain holes
			F Statement showing particulars and progress of various types of drilling bits

Chapter	*Title*	*Clause*	*Description*
			G Results of test samples of rocks H Excavation done for heal and toe of masonry dam (difference in levels to be indicated)
XIV	Construction plant layout and operation (materials and transportation)	1	General
		2	Quarries and borrow areas a) Aggregate recovery/stone quarries and borrow areas b) Aggregate/stone crushing c) Sand d) Random rubble stone e) Rock fill f) Earth (pervious, impervious and semipervious) g) Riprap
		3	Layout of approach roads from quarry/borrow areas to work areas
		4	Mode of quarrying/excavation of borrow material
		5	Transportation of materials
		6	Cement handling and storage
			Appendices A Monthly progress of quantities B Total materials used and monthly supply of materials actually utilised in dam C Royalty paid D Mode of acquiring quarries and their demarcation E Results of test sample for quality control of materials
XV	Material classification and processing and concrete/mortar manufacturing	1	Aggregate classification and processing
		2	Aggregate cooling
		3	Pozzolana manufacture/supply storage and transportation

Chapter	*Title*	*Clause*	*Description*
		4	Batching and mixing plant
		5	Earth and rockfill processing, if necessary
			Appendices
			A Total quantity and unit rate for aggregate classification and processing at screen house
			B The cost of equipment and its erection for the cooling plant
			C Analysis of unit rate of reclaiming the aggregate from the screen house and its cooling
			D Total quantity and analysis of unit rate of manufacture/supply of pozzolanas
			E Cost of equipment erection and operation of batching and mixing plant
			F Analysis of unit rate for batching material at batching plant
			G Total quantity and unit rate of various stone types at the construction site
			H Analysis of cost of earth work
			J Monthly progress of earth excavated and conveyed to site including cut off trenches
XVI	Concrete transportation and handling from batching point	1	Concrete transportation equipment
		2	Lifting and placement
			a) Trestles, cranes and cableways
			b) Rigging, erection of trestles and cableways
			c) Concrete pumps
		3	Haulage

Chapter	*Title*	*Clause*	*Description*
XVII	Masonry transport	1	Lifting, haulage and placement of rubble
		2	Mortar mixing and haulage to site
			Appendices
			A Specification of equipment
			B Information to be provided by electrical people on weights and measurements of electrically operated equipment
XVIII	Concrete/mortar placement	1	General
		2	Aggregate selection and blending
		3	Admixture in concrete
		4	Concrete/mortar mixes
		5	Quality control of concrete and admixtures
		6	Temperature control of concrete and cooling of concrete during placement
		7	Preparation of surfaces of concrete placement
		8	Concrete placement and vibration
		9	Finishing of concrete surfaces
		10	Repairs of concrete
		11	Concrete curing
		12	Construction joints
			Appendices
			A Analysis of rates for sand blasting
			B Typical analysis of rates for clean up
			C Statement showing analysis of rates per cubic metre of concrete placed by different methods at various sites

Chapter	*Title*	*Clause*	*Description*
			D Mortar and concrete test results
XIX	Earth and rockfill placement	1	Placement and compaction of earth/rockfill according to pervious, impervious and semipervious characteristics
		2	Quality control of placement
			Appendix
			A Chart showing daily compaction test results done
XX	Concreting of dam and appurtenant works	1	Dam
		2	Surplussing arrangement
		3	Expansion joints and keyways
		4	Trashrack structures
		5	Dissipation arrangements
		6	Training and guidewalls
		7	Spillway bridge, piers towers and visitors balcony
		8	Concreting of tunnels
		9	Miscellaneous works
			Appendices
			A Dam and appurtenant works; Monthwise progress of concreting
			B Statement showing unit rate of concrete placed in various positions of dam
			C Statement showing unit rate of concreting tunnels
			D Statement showing unit rate of concrete in penstock river outlets and trashrack structure

Chapter	*Title*	*Clause*	*Description*
			E Statement showing unit rate of concreting spillway bridge, piers, towers and visitors balcony
XXI	Rock pinning	1	Geology of the area to be treated with special reference to bedding planes and joint pattern
		2	Size and length of holes and their spacing
		3	Details of anchor rods used and arrangement for bolting
		4	Equipment used for drilling
			Appendix
			A Cost of rock pinning per square metre with details
XXII	Guniting	1	Proportion of mix
		2	Equipment used and pressure of air and water
XXIII	Masonry dam and appurtenant works	1	Size of block
		2	Foundation concreting
		3	Allowable stresses in heal and toe
		4	Zoning of masonry in terms of mortar mixes and type of masonry (first sort or second sort or random rubble)
		5	Dissipation arrangement
		6	Training and guide walls
		7	Spillway bridge, piers, transition, etc
		8	Drainage galleries
		9	Cross galleries
		10	Testing drilling and grouting
		11	Miscellaneous

Chapter	*Title*	*Clause*	*Description*
			Appendices
			A Dam and appurtenant works month-wise progress of quantities
			B Statement showing unit rate of masonry in various portions
			C Unit rate for drainage gallery
			D Statement showing unit rate of concrete in penstock river outlets and trashrack structure
			E Unit rate for face works
XXIV	Forms and embedded materials	1	Introduction
		2	Design of forms
		3	Forms for block joints, spillway bucket and downstream sloping spillway training walls
		4	Forms for galleries bridge and other openings in the dam
		5	Forms for spillway bridge and downstream balcony
		6	Forms for river oulet and penstock trashrack structures
		7	Forms for arch dams
		8	Forms for power plant
		9	Placement of forms
		10	Cooling and grouting pipe system
		11	Miscellaneous embedded material
			Appendices
			A Working stress table
			B Small tools used on form-work in the field
			C Unit rates for different types of form-works

Chapter	*Title*	*Clause*	*Description*
			D Quantities of various items of cooling and grouting pipe systems, embedded in dam
			E Details of tools required by a fitter and a group of filters
XXV	Reinforcement	1	Types of reinforcement bars used
		2	Types of splices
			a) Plain splicing
			b) Welded splicing :
			i) Lap welding
			ii) Butt welding
		3	Types of welding :
			a) Single welding
			b) Double welding
XXVI	Cooling of concrete and grouting of joints	1	Cooling of concrete
		2	Cement screening plant
		3	Flushing of contraction joints
		4	General procedure of joint grouting
		5	Grouting of longitudinal joints
		6	Grouting of transverse joints
		7	Contact grouting
		8	Contact grouting of embedded liners
		9	General observations
			Appendices
			A Data of cooling concrete for various grout lifts at dam
			B Effect of acid on concrete and embedded items
			C Unit rate for contraction joint grouting

Chapter	*Title*	*Clause*	*Description*
			D Lift-wise record of longitudinal, transverse and other joints grouted during dam construction
			E Cavity grouting of liners
XXVII	Instruments	1	Introduction
		2	Electrical/electronic instruments for observing temperature
		3	Piezometers
		4	Air flow meters
		5	Uplift pressure pipes
		6	Plumb line wells
		7	Gauge well
		8	Devices for movement and settlement observations
		9	Seismic observations
		10	Stress and strain meters
		11	Miscellaneous
XXVIII	Penstocks	1	Introduction
		2	Fabrication, stress relieving and testing
		3	Storage and transportation
		4	Installation and hydraulic testing
		5	Painting
		6	Gates and hoists
		7	Valves and bulk-heads
		8	Expansion couplings
		9	Fill and drain pipe system
		10	Piezometers

Chapter	*Title*	*Clause*	*Description*
		11	Repairs to liner
		12	Installation of hoists and their controls for intermediate operation of penstock head gates for power plant
			Appendices
			A Unit rate for fabrication
			B Unit rate for installation
			C Unit rate for painting
XXIX	River outlets	1	Introduction
		2	Fabrication/construction
		3	Storage and transportation
		4	Installation
		5	Painting
		6	Gates and hoists
		7	Emergency gates and gate frames
		8	Lifting beam
		9	Drain and fill pipes
		10	Piezometers
		11	Repairs to liner
			Appendices
			A Unit rate for fabrication/construction of outlet liner
			B Unit rate for installation
			C Unit rate for painting
XXX	Surplussing gates and hoists	1	Fabrication
		2	Transportation
		3	Installation and seals
		4	Painting
		5	Hoists

Chapter	*Title*	*Clause*	*Description*
			Appendices A Unit rate for fabrication B Unit rate for installation C Unit rate for painting
XXXI	Crane hoist and elevators in dam	1	Gantry crane
		2	Trolley hoist
		3	Elevators
XXXII	Aerial ropeway and timber transport	1	Introductory
		2	Log boom
		3	Inclined carriageway and loading station
		4	Aerial ropeway
		5	Unloading station
		6	Ropeway cables
			Appendix A Unit rate for timber transportation
XXXIII	Trashrack, stoplogs and slot covers	1	Trashracks A Fabrication and painting B Installation
		2	Stoplogs
		3	Slot covers
			Appendices A Unit rate for fabrication B Unit rate for installation C Unit rate for painting
XXXIV	Job facilities	1	Power supply
		2	Transmission and distribution of power

Chapter	*Title*	*Clause*	*Description*
		3	Compressed air
		4	Ice plant
		5	Lighting of works area
		6	Fire fighting organization
		7	Human safety
		8	Medical facilities
		9	Storage and handling of explosives
		10	Research and field laboratories
		11	Water treatment plant and water supply arrangements
		12	Storage and handling of petrol, oil and lubricants
		13	Pumps for works
		14	Oxygen plant
		15	Acetelyne plant
			Appendices
			A Power requirements of various plants and equipment in operation on the project
			B Distribution sub-stations
			C Fire service equipment
			D Unit rate of water
			E Quantities of fuel oils and lubricants consumed during different years
			F Important pumps used during the construction of dam and power plant
			G Pumps installed permanently in dam and power plant
XXXV	Stores including spare parts	1	Procurement
		2	Warehousing
		3	Disposal of surplus stores

Chapter	*Title*	*Clause*	*Description*
			Appendix
			A Graph showing accumulated stores such as cement, steel, petrol, oil, lubricant, spare parts etc, received and stores issued
XXXVI	Power plant mechanical installation	1	Draft tubes scrolls casings, draft pipes and pit liners
		2	Draft tube bulk-head gates
		3	Draft tube gantry crane
		4	Elevator
		5	Piping systems
		6	Grouting system
XXXVII	Workshops	1	Workshop and ancillary equipment a) Foundary shop b) Smithy shop c) Machine shop d) Structural shop e) Welding shop f) Fitting and assembling shop g) Tyre retreading shop h) Carpentry shop j) Paint shop k) Millwright shop m) Galvanizing shop, and n) Field repair shops, such as carrier repair shop, tractor repair shop, auto shop, pipes and pumping shop, and drill and bit repair shop
		2	Maintenance and repair to mechanical equipment and heavy earth moving machinery
		3	Reinforcement yard

Chapter	*Title*	*Clause*	*Description*
		4	Electrical repairs shop
		5	Rigging loft
			Appendix
			A List of major equipments installed in different shops
XXXVIII	List of plant and machinery	1	Drilling and grouting equipment a) Compressed air distribution system b) Diamond drills c) Core drilling machine with prime mover d) Wagon drills e) Jack hammers f) Pavement brakes g) Grouting equipment like grout mixers, pumps, pressure gauges, packers, etc
		2	Transport equipment a) Trucks of 5 to 20 ton capacity b) Motorized tanker (3 636 to 9 090 litre capacity) c) Trailers d) Pneumatic tyred tractors e) Jeeps, cars, station wagons, pickups f) Station wagons g) Ambulances h) Pickup vans j) Railway locomotive and rolling stock k) Buses m) Mobile cranes
		3	Water supply (works and dewatering arrangement)

Chapter	*Title*	*Clause*	*Description*
		4	Electrical equipment
			a) Generators
			b) Motors
			c) Weldings
			d) Flood lights
		5	Compaction equipment
			a) Road rollers (8 to 12 tons)
			b) Sheep foot rollers
			c) Pneumatic tyred rollers (20 to 50 tons)
			d) Vibratory rollers
		6	Construction plant
			a) Crushers, classifiers
			b) Washing and cleaning plants for aggregates
			c) Batching plants
			d) Refrigerating plant
			e) Screening plants
			f) Reclaiming plants
			g) Belt conveyor
			h) Cranes, wagons, cement silos and cement pumping plant
			j) Surkhi/pozzolana manufacturing plant
			k) Concrete mixers and pump crete
			m) Transit mixers
			n) Mortar mills
			p) Cranes and buckets for transporting concrete
			q) Portable vibrators (electric pneumatic, diesel and petrol) and
			r) Tram lines and related equipment

Chapter	*Title*	*Clause*	*Description*
		7	Earth moving equipment a) Shovels (electric and diesel) and draglines b) Scrapers (motorized and tractor drawn) c) Overhead and crawler front-end loaders (tyred and tractor type) d) Crawler tractors : dozer and rippers e) Wheeled tractors : dozer and rippers f) Motor graders g) Carriers, such as bottom dumpers, rear dumpers and side dumpers h) Belt loaders, elevating graders j) Tipper trucks k) Trenchers m) Wheeled excavators n) Water tankers
		8	Miscellaneous equipment a) Hoists b) Pulley block, lifting tackle gantries c) Winches d) Other lifting machines
		9	Workshop and ancillary equipment (*see* Chapter XXXVII)

2.4 Design and Construction of Power Plant — This part may have the following chapters and clauses:

Chapter	*Title*	*Clause*	*Description*
I	Introduction		
II	Investigations and planning	1	General
		2	Hydrology, water power studies with working tables

Chapter	*Title*	*Clause*	*Description*
		3	Number of units, sizes and hydraulic features
III	Design	1	Civil Works
			a) Layout and type of structures
			b) Hydraulic features
			c) Main unit bays
			d) Service bay
			e) Control bay
			f) Access to dam
			g) Cable tunnels/trenches
			h) Stability analysis and foundation treatment
			j) Slope treatment
			k) Surface and subsurface drainage
			m) Tail race
			n) Architectural treatment
			p) Joints and seals
			q) Structural design and supports system provided for underground cavities
			r) Second stage concreting
			s) Switch yard structure and foundation
		2	Power plant equipment
			a) General
			b) Description of system
			c) Inlet valve
			d) Turbines
			e) Governors
			f) Generators
			g) Excitation system
			h) Generator buses
			j) Main step up transformer
			k) EHV switch gear

Chapter	*Title*	*Clause*	*Description*
			m) Control protection and annunciator system
			n) Grounding
			p) EOT crane
			q) Station service system
			r) Unit auxiliary power system
			s) Direct current system
			t) Communication system
			u) Lighting system
			v) Control and power cables
			w) Lighting protection
			x) Metering and recording
			y) Conduits, cable racks and supports
			z) Electrical laboratory
		3	Mechanical auxiliaries
			a) General
			b) Unit cooling water system
			c) Service water system
			d) Fire protection system
			i) Water system for fire protection
			ii) Carbon dioxide fire protection system
			e) Compressed air system
			f) Drainage and dewatering system
			g) Air conditioning and ventilation
			h) Piping
			j) Governor and lubricating oil system
			k) Transformer oil system
			m) Draft tube gates
			n) Draft tube gates gantry crane
			p) Elevators

Chapter	*Title*	*Clause*	*Description*
			q) Machine shop
			Appendix
			A Specifications for turbines and generators and other plants like EOT cranes, transformer, bus duct connections, control and relay panel, AC/DC auxiliary system, EHV switch gear
IV	Construction	1	Organization
		2	Plant
			a) Aggregate manufacture, processing and transportation plant
			b) Aggregate cooling plant
			c) Cement handling and storage plant
			d) Concrete batching and mixing
			e) Trestle
			f) Crane
			g) Compressed air, water and electric supply facilities
		3	Construction activities
			a) Coffer dam
			b) Excavations
			i) Excavation of approach tunnel/roads
			ii) Excavation of underground power house, cavities and slopes
			iii) Excavation of foundations and tailrace
			iv) Excavation of penstock tunnel
			v) Excavation of cable tunnel
			vi) Back fill
			vii) Disposal of excavated material

Chapter	*Title*	*Clause*	*Description*
			viii) Dewatering
			c) Foundation treatment
			i) Foundation drainage
			ii) Grouting and drainage of upstream and downstream of back slopes
			d) Forms
			e) Reinforcement steel
			f) Concreting
			i) Power house main building and draft tubes
			ii) Second stage concreting
			iii) Tail-race
			iv) Penstock tunnels
			v) Cable tunnel
			vi) Rail and road tunnel
			g) Power house equipment
			i) Erection of embedded parts
			ii) Erection of speed ring and scroll case including hydrostatic testing
			iii) Sequence of erection of other turbine parts
			iv) Erection of inlet valves
			v) Sequence of erection of generator parts, such as stator, rotor and other components
			vi) Erection of other major plants and machinery of power house, such as :
			— Generator buses
			— Main step up transformers
			— EHV switch gear
			— Control protection and annunciator system

Chapter	*Title*	*Clause*	*Description*
			— Grounding
			— EOT crane
			— Station service system
			— Unit auxiliary power system
			— Direct current system
			— Communication system
			— Lightening protection
			— Lighting system
			— Control and power cables
			— Metering and recording
			— Conduits, cable racks and supports
			— Electrical laboratory
			— Water system for : Unit cooling Service
			— Fire protection system for : Water system for fire protection Carbon dioxide fire protection system
			— Compressed air system
			— Drainage and dewatering system
			— Air conditioning and ventilation system
			— Piping
			— Oil system for : Governor and lubrication Transformers
			— Draft tube gates and gantry crane
			— Elevators
			— Machine shops

Chapter	*Title*	*Clause*	*Description*
			— Switch yards for : Civil structures Alternative drainage system
		4	Costs for electrical plant and machinery as indicated above

Appendices

A Statistical summary
B Studies
C Personnel
D Major purchases
E Completion drawings
F Bar chart showing the erection sequence including duration
G Details of pre-commissioning test
H Power house on permeable foundation
  i) Dewatering arrangements
    — well points
    — vaccumatic pumps
    — well point lines
    — deep tube wells installed to overcome artisian pressures
  ii) Sheet piles and erection
  iii) Raft foundation
  iv) Concreting of raft foundation

2.5 Design and Layont of Barrages, Weirs and Head Works — This part may have the following chapters and clauses :

Chapter	*Title*	*Clause*	*Description*
I	Introduction	1	General
		2	Geography, topography and regional geology
		3	Earthquake hazards, seismic vulnerability and seismic consideration
		4	River(s) and hydrology

Chapter	*Title*	*Clause*	*Description*
		5	History and origin of the proposal, developments leading to various designs
		6	Scope, cost and benefit of the project
		7	Basic data
		8	Agency for design
II	Design	1	Introduction
		2	Early schemes with various alternatives considered
		3	Design features as originally envisaged before construction
		4	Final design features as adopted
		5	Location of the barrage/weir and head regulator
III	Diversion works	1	General a) Diversion plan b) Sequence of diversion operation c) Design floods
		2	Diversion channels a) General b) Design of channels c) Closure schedule
		3	Coffer dam a) Layout and type b) Heights of coffer dams c) Design of section
IV	Barrage/weir and head regulator(s)	1	Geology a) Introduction b) Foundation geology
		2	Choice of type of structure a) Materials of construction b) Other considerations such as combining other facilities like

Chapter	*Title*	*Clause*	*Description*
			road/railway bridges, permissible afflux, dewatering problems, siltation, etc
		3	Foundations
			a) Problems encountered
			b) Treatment of foundations
			c) Foundation drainage
		4	Barrage/weir
			a) Hydraulic data/features, such as gauge-discharge values, retrogression assumed, sediment data, looseness factor, scour factors, coefficient of discharge, exit gradient values, waterway, intensit of discharges in spillway/under sluice/river sluice, energy dissipation, protection works provided, etc
			b) Structural data/features such as stresses allowed in concrete / masonry /steel/foundation, factors of safety allowed in sliding and overturning, various conditions of maximum water level, pond level, tail water level saturation, earthquake, etc, considered for stability analysis of the different components of the barrage
			c) Details of the components of the barrage/weir like abutments, raft/gravity floor, wing walls, return walls, flared out walls, single pier, double piers, divide walls, silt excluder devices, afflux bunds, tie bunds, guide bunds rail/road bridges, etc

Chapter	*Title*	*Clause*	*Title*
			d) Details of control arrangements like gates, stoplogs, hoist bridge, falling shutters, etc. Details of hoisting arrangements
			e) Details of instrumentation provided, if any, like uplift pressure pipes, stress meters, strain meters, tell tales, gauge wells, etc
			f) Details of facilities like fish ladder log chutes, navigation lock, etc, provided if any
			g) General features like architectural treatment provided if any, observation points for visitors, etc, provided if any
		5	Head regulator(s)
			a) Hydraulic data/features such as depth-discharge curve, scour factors, coefficient of discharge waterway, intensity of discharge, energy dissipation, protection works, etc
			b) Structural data/features, such as stresses allowed in concrete/masonry/steel foundation, factors of safety allowed in sliding and over-turning; various conditions of maximum water level, round level, tail water level, saturation, earthquake, etc, considered for the stability of the different components of the barrage
			c) Details of the components of the head regulator (s) like abutments, raft/gravity floor, return walls, piers, bridges, trashrack, breast wall, etc
			d) Details of control arrangements like gates (single of

Chapter	*Title*	*Clause*	*Description*
			multi-tiered), stop logs, hoist bridge, etc
			e) Details of instrumentation provided, if any
			f) Details of special provisions if any like steel cladding of piers, de-icing arrangements like heating of gates by air bubbler system, etc
			Appendices
			A Geology and investigation of the barrage/weir site
			B Model test reports of research stations, if any
			C Model test reports of research stations, if any

2.6 Design and Layout of Canal Distributaries for Irrigation, Navigation and Water Supply

2.6.1 *Irrigation* — This part may have the following chapters and clauses

Chapter	*Title*	*Clause*	*Description*
I	Brief description and history	1	Brief details of the scheme, proposals and description of the works
		2	Historical background describing socio-economic aspects of the area, population and important towns and network of roads and rail system existing modes of cultivation and irrigation and areas existing under forecasting, grazing and wastes. Crops grown in accordance with choice of the local people, seasons of cultivation, details of rainfall, climate and temperature. Agricultural and other main industries and also transportation facilities
		3	Necessity for irrigation briefly describing the opportunities for development of the areas as a result of introduction of the irrigation facilities

Chapter	*Title*	*Clause*	*Description*
II	Sources of irrigation and water supply	1	Surface water with brief description of the historical stream/river/reservoir as the main source of water supply for irrigation, describing topography, catchment, rainfall, surface-run-off and flood estimation of the area
		2	Ground water supply of the area
		3	Types and concentration of dissolved and suspended materials for determining the suitability of water for various purposes such as irrigation, domestic and industrial uses
III	Agricultural aspects	1	Soil surveys with brief description of their profile, texture, permeability and fertility, determination of areas commanded and irrigated
		2	Chemistry of soils describing special problems, such as presence of salinity or alkalinity, limitations and their remedial measures
		3	Crop pattern describing crop seasons, crops grown, water requirement, frequency, timing, depth of water and delta
		4	Water allowance and irrigation efficiency
		5	Improved techniques (modern technique) describing improvement in modes of cultivation and irrigation, improvement in cropping pattern and the need for training facilities and demonstration farms
		6	Increased use of high yielding varieties and fertilizers
IV	Alignment of canals	1	a) Description of canal system including surveys, investigation and exploration like trial pits for alternative alignments and factors leading to

Chapter	*Title*	*Clause*	*Description*
			final choice and to further changes in the alignment during execution
			b) Necessity of resorting to deep cuts and consequent avoidance of slips, economical aspects considered while fixing up of alignment of canals including geotechnical studies of the rock structure met with such as angle of slip, nature and type of stratification likely to be met with during finalization of alignment along deep cuts etc
		2	Land acquisition for construction of canal system
		3	Sediment control and desilting works like silt ejectors
		4	Necessity of other structures like bridges, regulators, escapes, cross drainage work, falls, etc
		5	Necessity in land shaping and land levelling
		6	Field channels and water courses and their maintenance
		7	Rostering of water distribution particularly during the peak demand period and role of local people
		8	Canal telegraph system
V	Design	1	a) Design aspects of canal system describing factors leading to arrive at Lacey's silt factor or rugosity factor, slope, full supply depth, width and side slopes
			b) Design aspects in finalising the economical flume section with suitable transitions depending upon the type of

Chapter	*Title*	*Clause*	*Description*
			rock stratification met with during transverse planes, deep cuts excavation keeping in view the immediate and final requirement of water for creating irrigation potential stage by stage
		2	Factors leading to the remodelling of the existing structures
		3	Design of bridges, regulators, cross drainage works, silt ejectors and other desilting devices, falls, meter flumes, control points, escapes, etc
		4	Hydraulic particulars such as permissible velocity, full supply discharge, full supply level, bed level, bed width and free board
		5	Water losses and their remedial measures including lining of the canal system
		6	Design with the rugosity coefficient used for the lining selected and construction of lining of canal system and drainage behind lining
VI	Construction problems of canal earth work excavation in various strata and construction of embankment	1	Machinery, animal and manual labour used for construction
		2	a) Side slopes for cutting and slopes for embankment b) Fixing of suitable side slopes depending upon the type of rocky structures met with in deep cuts, protective measures taken to avoid major slips in the deep cuts such as easening of slopes, providing reverse slopes on berms after paving the same with the lining concrete, effective drainage, conducting detailed and thorough geological mapping of deep cuttings before taking up of

Chapter	*Title*	*Clause*	*Description*
			deep cut lining to identify the potentially stable reaches, discussions of remedial measures taken, such as rock bolting, perfo bolting, grouting, etc
		3	Zoning of embankment and their compaction
		4	Provision of berms, inspection banks
		5	Spoil banks
		6	Surface drainage
		7	Plantation
VII	Lining of canals	1	Types of lining considered and final selection
		2	Details of lining works
		3	Drainage behind lining such as back-fill and filter material and pressure relief valves
VIII	Construction problems of masonry works	1	Exploration of foundations
		2	Excavation techniques
		3	Pumping and dewatering
		4	Concreting
		5	Changes made in the designs during execution
		6	Availability of construction materials and their transportation
IX	Water logging and drainage congestion	1	Fluctuations of sub-soil water levels in the areas irrigated, its effects on the root zones of the plants
		2	Rise in water table giving rise to water logging and drainage congestion and its effects on agricultural produce including on the health of people due to malaria

Chapter	*Title*	*Clause*	*Description*
		3	Drainage for the commanded area
		4	Remedial measures for anti-water logging and material control
		5	Conjuctive use of surface and ground water
X	Socio-economic development and revenues	1	A brief description of irrigation development, and the period needed for full benefits of irrigation facilities introduced
		2	Increase in agricultural produce, improvement in roads and communication systems, marketing and other facilities and impact on socio-economic development of the area
		3	Existing water rates and land revenue
		4	Quantum and mode of collection of betterment levy, the legislation in force, proposals envisaged in the project proposals regarding new water rates and betterment charges and the reaction of the local people to this effect
XI	Details of actual cost of construction under various sub-heads, such as (a) preliminary (b) land (c) works (d) regulators (e) bridges (f) building, etc		
			Appendices Unit rates for various items of work, namely
			A Rates of excavation of canal for various types of soils per cubic metre including details of explosive used if any
			B Unit rate per cubic metre of excavation in foundation in various strata, masonry work, concreting, RCC, works, lining of canal with various materials

Chapter	*Title*	*Clause*	*Description*
			C Unit rate for canal embankment including compaction
			D Types and numbers of inspection bungalows and staff quarters
			E Hydraulic surveys of canals, branches and distributaries regarding full supply level, bed level, bed width, free board, design discharge in various reaches, silt factor, duty gauge and discharge data
			F Statement showing sub-soil water level
			G Statement showing rainfall, temperature and evaporation details
			H Details of equipment used for the construction of canals, cross-drainage works and other masonry structures

2.6.2 *Design and Construction of Navigation Canal System* — This part may have the following chapters and clauses :

Chapter	*Title*	*Clause*	*Description*
I	Brief description and history	1	Brief details of the scheme, proposals and description of the work
		2	Historical background describing socio-economic aspects of the area, population and important towns and network of roads, rail systems existing industrial and agricultural products of the area. Centres of export and import along the proposed route. Expected passenger traffic
		3	Necessity for navigation, briefly describing the opportunities for development of the area as a result of introduction of the navigational facilities

Chapter	*Title*	*Clause*	*Description*
II	Sources of water supply for the navigational canal system	1	Brief description of the historical stream/river/reservoir as the main source of water supply
		2	Description of the irrigation canal system, which will be utilized for the purpose of navigation as well
III	Investigational aspects	1	Soil surveys with brief description of the soil profile, texture, permeability and ground water table
		2	Survey along the alternative routes to find the available hydraulic gradients suitable for navigation purpose. Avoidance of land acquisition problems, at the same time touching major villages
		3	Type and frequency of vessels expected to ply
		4	Maximum size and tonnage of the vessels
		5	Economic comparison with other available modes of transport
IV	Alignment of canals	1	Description of the final alignment selected including surveys, investigations and exploration like trial pits for alternative alignments and facor leading to final choice and to further changes in the alignment during execution
		2	Land acquisition for construction of the canal system
		3	Sediment control
		4	Navigational locks, their location, needs and justification
		5	Selection of loading and unloading points
		6	Necessity of other structures like,

Chapter	*Title*	*Clause*	*Description*
			bridges, falls and cross drainage works
		7	Necessity in land shaping and approach
		8	Smaller navigational branch canals
		9	Other available communication systems along the alignment
V	Design	1	Design aspects of the canal system describing factors leading to arrive at the slope, navigational depth, width and side slopes
		2	Design of jetties, inland ports and locks
		3	Factors leading to the remodelling of the existing structures
		4	Design of bridges, cross drainage works, falls, etc
		5	Hydraulic particulars such as permissible velocity, supply discharge, navigational levels, size of locks, filling and emptying time, etc
VI	Lining of canal	1	Necessity of lining
		2	Type of lining considered and final selection
		3	Details of lining work
		4	Drainage behind lining such as backfill and filter material and pressure relief valves
VII	Construction problems	1	Exploration of foundations
		2	Machinery, animal and manual labour used for construction
		3	Pumping and dewatering
		4	Compaction of embankments

Chapter	*Title*	*Clause*	*Description*
		5	Spoil banks
		6	Surface drainage
		7	Plantation
		8	Concreting
		9	Changes made in the designs during construction
		10	Availability of construction material and their transportation
VIII	Water logging and drainage congestion	1	Fluctuation of sub-soil water levels in the area around the canal
		2	Rise in water table giving rise to water logging and drainage congestion including on the health of the people due to malaria
		3	Remedial measures for anti-water logging and malaria control
IX	Socio-economic development and revenues	1	A brief description of navigational development and period needed for full benefits of navigation facilities introduced
		2	Increase in industrial and agricultural growth in the area, and impact on socio-economic development of the area
		3	Revenue earning
		4	Reaction of the local people on the project
X	Details of actual cost of construction under various sub-heads such as : a) Preliminary, b) Land, c) Works, and d) Buildings		

Chapter	*Title*	*Clause*	*Description*
			Appendices
			A Unit rates for various items of work, namely :
			a) Rate of excavation for various types of soil
			b) Rate of excavation in foundation, rate of masonry, concreting and RCC works
			c) Unit rate for canal embankment, including compaction
			B Type and number of jetties, ports, etc
			C Statement showing sub-soil water levels
			D Details of equipments used during construction

2.6.3 *Design and Construction of Canal System for Water Supply to Towns, Industries and Thermal Power Stations* — This part may have the following chapters and clauses :

Chapter	*Title*	*Clause*	*Description*
I	Brief description and history	1	Brief details of scheme, proposals and description of the works
		2	Historical background describing socio-economic aspects of the area, population and important towns and network of roads and rail system, existing details of rainfall, climate and temperature
		3	a) Background of present population, industries and basis of water requirement.
			b) Capacity of thermal power station proposed and future indicating respective demands
			c) Consumptive and non-consumptive requirements of water should be brought out

Chapter	*Title*	*Clause*	*Description*
		4	Necessity for providing water supply briefly describing the opportunities for development of the area as the result of introduction of water supply facilities
II	Sources of water supply	1	Surface water with brief description of the historical stream/river/reservoir as the main source of water supply describing topography catchment, rainfall, surface run-off and flood estimation of area and brief description of head works
		2	Ground water supply of the area a) Sub-soil water levels during pre-monsoon and post-monsoon. Type of acquifer met, at various levels. Ground water recharge studies if done may be described
		3	Types and concentration of dissolved and suspended material for determining the stability of water for water supply for domestic, industrial and other uses
III	Alignment of canals	1	Description of canal system including surveys, investigation and exploration like trial pits, for alternative alignments and factors leading to final choice and to further changes in the alignment during execution.
		2	a) Soil survey through which canal passes indicating type of strata and permeability of soil so as to justify the provision of lining b) Investigation giving brief details of investigation carried out indicating type of soil and sub-soil water level (pre- and post-monsoon) in the

Chapter	*Title*	*Clause*	*Description*
			area of canal. The availability of construction material such as earth, sand, aggregate, brick, stone and cement. The bearing capacity of soil at important structures.
		3	a) Land acquisition for construction of canal system b) Sediment load in the canal and measures to remove the excessive sediment
		4	Necessity of other structure like bridges, regulators, escapes, cross-drainage-works, falls etc
		5	Necessity of providing inspection path on one side or both
		6	a) Availability of water at source indicating dependability b) i) Normal demand of water ii) Peak demand of water c) Provision of subsidiary reservoirs, if any, to cater for peak demands
		7	Restoring of water distribution particularly during peak demand period and role of local people, and regulation of water supply
		8	Telecommunication system a) From head works to important points of canal b) From head works to industry, town/thermal power plant
IV	Design	1	a) Fixing capacity of canal for normal present and future demands b) Capacity required to meet with peak demands

Chapter	*Title*	*Clause*	*Description*
			c) Future capacity of canal if kept may be brought out
		2	Design aspects of canal system describing factors leading to arrive at Lacey's silt factor of coefficient of rugosity, bed slopes, full supply depth, width and side slopes.
		3	Factors leading to remodelling of the existing structures, if any
		4	a) Brief design criteria and assumptions of bridges, regulators, cross drainage works, silt ejectors and other desilting devices, falls, flumes, escapes, etc
			b) Present and future capacity of each structure may be brought out
		5	Hydraulic properties such as permissible velocity, full supply discharge, full supply level, discharge coefficient adopted
		6	Water losses and the remedial measures including lining of canal system
		7	Design with the rugosity coefficient used for the lining selected and construction of lining of canal system and drainage behind lining
V	Construction problems of canal earth work excavation in various strata and construction of embankment	1	Machinery, animal and manual labour used for construction
		2	Side slopes for cutting and slops for embankment
		3	Zoning of embankment and their compaction
		4	Provision of berms to inspect banks
		5	Spoil banks

Chapter	*Title*	*Clause*	*Description*
		6	Surface drainage
		7	Plantation
VI	Lining of canals	1	Type of lining considered and selection
		2	Details of lining work
		3	Drainage behind lining such as back fill and filter material and pressure relief valves
VII	Construction problems of masonry works	1	Exploration of foundation
		2	Excavation techniques
		3	Pumping and dewatering
		4	Concreting
		5	Changes made in the design during execution
		6	Availability of construction material and its transportation
		7	Problems of existing structure located on or near the alignment
VIII	Water logging and drainage congestion	1	Fluctuation of sub-soil water level in the area
		2	Rise in water table as a result of seepage of water and drainage congestion and its impact on existing building and health of people
		3	Remedial measures to lower the subsoil water and preventing water logging and malaria control
		4	Dewatering of sediment water in low pockets by pumping or gravity drains
IX	Socio-economic development and revenues	1	Brief description of water supply system and its development
		2	Present industries and population and

Chapter	Title	Clause	Description
			the future development of small scale industries and major industries. Increase in production increase in national income
		3	a) Proposed method of measuring or metering the water supply to each consumer b) Rate of charging the bulk supply from consumers c) Anticipated revenues per annum and the maintenance cost per annum
X	Details of actual cost of construction under various sub-heads such as : a) Preliminary b) Land c) Works d) Buildings e) Cross drainage works regulators		
			Appendices A Unit rates of various items of works namely a) Rate of excavation for various types of soil b) Rate of excavation in foundation, rate of masonry, concreting and RCC works c) Unit rate for canal embankment, including compaction d) Unit rate of lining, drainage system

Chapter	*Title*	*Clause*	*Description*
			B Statement showing sub-soil water levels
			C L-Section of canal indicating the type of soil and the discharges in various reaches and water levels
			D Details of equipment used during construction
XI	Maintenance and operation	1	Organizational set up for operation and maintenance of canal
		2	Major details of operation and maintenance of canal
		3	Maintenance of cross-drainage works, bridges, escapes etc
		4	Measurement of discharges and to assess the seepage losses in various reaches

2.7 Design and Layout of Power Transmission and Distribution System — This part may have the following chapters and clauses :

Chapter	*Title*	*Clause*	*Description*
I	Introduction		
II	Planning	1	Choice of transmission voltage
		2	Power system studies
		3	Transmission system
III	Alignment of transmission lines	1	Route survey, investigation and exploration like trial pits for alternative alignment and factors leading to final choice and to further changes in the alignment during execution
		2	Land acquisition for towers
		3	Necessity of other structures like towers for crossing rivers, roads, railway-lines etc
IV	Design	1	Civil works

Chapter	*Title*	*Clause*	*Description*
		2	Tower structures and foundations
		3	Transmission line equipment
			a) General
			b) Conductors and conductor accessories
			c) Insulators and hardwares
			d) Ground wires
			e) Other line materials
			f) Other miscellaneous items
			Appendices
			A Specification for tower structures
			B Specifications of conductors and conductor accessories, insulators and hardwares and ground wires etc
V	Construction	1	Organisation
		2	Plant
			a) Trestle
			b) Crane
			c) Cement handling plant
			d) Compressed air, water and electric supply facilities
			e) straining equipment
		3	Construction activities
			a) Towers
			b) Insulators and hardwares
			c) Conductors and accessories
			d) Ground wires
			Appendices
			A Statistical summary
			B Studies

Chapter	*Title*	*Clause*	*Description*
			C Personnel
			D Major purchases
			E Completion drawings relating to layout of power system, connections to grid sub-stations etc
			F Bar-chart showing the erection sequence including duration
			G Details of pre-construction test
			H Construction problems
VI	Details of actual costs under various sub-heads such as		
			a) Preliminary
			b) Land
			c) Building
			d) Miscellaneous
			e) Maintenance
			f) Equipment
			g) Special tools and plants

3. OPERATION MAINTENANCE AND OBSERVATION

3.0 This should form an Annexure to design, model studies and construction features [*see* **2**] and should contain the detailed instructions for the operation, maintenance and observation of various components and may be prepared in the following parts :

a) Reservoir,

b) Dam, barrage, weir

c) Power plant civil structure

Chapter	*Title*	*Clause*	*Description*
			piping system and mechanical accessories,
			d) Canal system,
			e) Power plant, switchyard etc, and
			f) Flood embankment

These parts may be further subdivided into chapters and items as detailed in 3.1 to 3.6 and may contain any other aspects peculiar to the particular project.

3.1 Reservoir — This part may have the following chapters and clauses:

Chapter	*Title*	*Clause*	*Description*
I	Introduction		
II	Reservoir operation and use of water	1	General
		2	Modes of water releases
			a) Penstocks
			b) River outlets
			c) Spillway
			d) Through other devices
		3	Gauging facilities for inflow and outflow
		4	Storage utilization
			a) Water indents
			b) Flexibility in releases of indents
			c) Storage capacity
			d) Control of reservoir
			e) Releases in the interest of irrigation
			f) Reservoir factor chart

Chapter	*Title*	*Clause*	*Description*
			g) Releases in the interest of power
			h) Releases for the passage of floods
			j) Releases in the interest of passage of density currents, etc
			k) Releases in the interest of industry
			m) Releases in the interest of navigation
			n) Releases in the interest of ecology
			p) Releases in the interest of pollution control
		5	a) Normal release
			b) Disposal of flood and surplus flows
			c) Precautions
		6	Flood-warnings
		7	Recreation
		8	Navigation
		9	Timber transport and handling
		10	Games and sports including wild life
		11	Pisciculture
		12	Forests and vegetations
		13	Upstream abstraction
		14	Use of water in the foreshore
III	Observation on reservoir	1	Sedimentation studies
			a) Sediment surveys
			b) Sediment sampling
			c) Density currents

Chapter	*Title*	*Clause*	*Description*
		2	Lake settlement
		3	Evaporation losses
			a) Measurements
			b) Reports and record
		4	Meteorological and hydrological observations
			a) Temperature observations
			b) Rainfall observations
			c) Wind measurements
			d) Discharge measurements
IV	Soil conservation	1	Engineering
			a) Check dams (settling basin, debris basin, sedimentation basin)
			b) Vegetative screens
			c) Contour bending and trenching
			d) Gully plugging
		2	Agronomical
			a) Retirement of severely eroded cultivated land for permanent protection by vegetation
			b) Planting severely erodible areas with feed and cover plants for rehabilitation of wild life
			c) Pasture development and their protection
			d) Construction of small water storage
			e) Vegetated water ways
			f) Contour farming by bunding and terracing
			g) Strip cropping

Chapter	*Title*	*Clause*	*Description*
			h) Stubble mulch farming
			j) Seasonal cover crops
			k) Crop rotation
		3	Forestry
			a) Fire protection in forest areas of the catchment
			b) Conservation plans for range-lands
			c) Regulated felling of trees
			d) Working plan for proper management of the forest and for its regeneration in the catchment area

3.2 Dam Barrage, Weir — This part may have the following chapters and clauses :

Chapter	*Title*	*Clause*	*Description*
I	Introduction		
II	Instrumentation data and their interpretation	1	Pattern of seepage
		2	Analysis of water samples
		3	Uplift
		4	Drainage flow from joint drains and intermediate drains
		5	Settlement and movement of the dam blocks, abutment and rock rib downstream of dam
		6	Strain meters, stress meters, joint meters and thermometers
		7	Plumb line
		8	Piezometers and pore pressure observed
		9	Settlements in earthen dams
		10	Air flow
		11	Remedial measures
			a) Foundation drainage

Chapter	*Title*	*Clause*	*Description*
			b) Foundation grouting
III	Penstocks	1	Filling and drainage of penstocks
		2	Penstocks gates and hoists a) Gate operation b) Maintenance
		3	Stoplogs a) Special precautions b) Maintenance guide
		4	Trashrack maintenance
		5	Expansion coupling a) Instructions for inspection b) Precautions
		6	Penstock liner inspection and maintenance
		7	Drainage behind penstocks
IV	River outlets	1	River outlet gates and hoists
		2	Emergency bulk head gates and lifting beam
		3	Trashrack
		4	River outlet liner
		5	River outlet fill and drain pipes
		6	Air supply system
V	Spillway	1	Drainage arrangements for training walls and apron slab
		2	Spillway gates, their number, sequence of operation and flow warnings
		3	Gates and hoists
VI	Cranes and lifting gear	1	Gantry crane
		2	Overhead travelling crane
		3	Trolley hoists

Chapter	*Title*	*Clause*	*Description*
VII	Water supply and sewage disposal	1	Raw water supply
		2	Treated water supply
		3	Sewage disposal
VIII	Electrical equipment	1	Power and control system HT/LT power system
		2	Lighting distribution system a) Indoor lighting of dam b) Outdoor lighting of dam c) Illumination in dam
		3	Grounding system
		4	Telecommunication system
		5	Lifts
IX	General maintenance	1	Concrete and concrete surfaces
		2	Metal work
		3	Drainage a) Surface drainage b) Sub-surface drainage c) Internal drainage of the dam d) Foundation drainage

3.3 Power Plant Civil Structures, Piping System and Mechanical Accessories — This part may have the following chapter and clauses :

Chapter	*Title*	*Clause*	*Description*
I	Uplift relief and grouting system with permissible uplift head		
II	Settlement		
III	Joints and seals		
IV	Upstream backfill drainage		

Chapter	*Title*	*Clause*	*Description*
V	Penstock and draft tube filling and dewatering system		
VI	Draft tube gates and gantry crane		
VII	Seepage and floor drainage		
VIII	Main overhead cranes		
IX	Concrete surfaces		
X	Cooling water system		
XI	Service water system		
XII	Filtered water system		
XIII	Treated water system		
XIV	Fire protection water system		
XV	Sanitary system		
XVI	Governor and lubricating oil handling system		
XVII	Transformer oil handling system		
XVIII	Compressed air system		

Chapter	*Title*	*Clause*	*Description*
XIX	Air conditioning and ventilation		
XX	Structural steel, steel glazing and railings		
XXI	Rolling shutters, fire doors and lifts		
XXII	Maintenance of switchyards civil structures		

3.4 Canal System — This part may have the following aspects :

a) Organisational set up for operation and maintenance of canal system and collection of irrigation revenue

b) Major details of opertion and maintenance schedule of main canals, branch canals and distributaries, weed problems and steps taken to control it. Silt problem of canals distributaries minors and steps taken to control it. Hydraulic surveys of canal distributaries and miners

c) Maintenance and inspection schedule of canal embankments, cross drainage works and communication system

d) Observation of seepage losses and actual coefficient of rugosity

3.5 Power Plant, Switch Yard etc — This part may have the following chapters and clauses :

Chapter	*Title*	*Clause*	*Description*
I	Inlet valves	1	Valves
		2	Governing system
II	Turbines	1	Turbine components like shafts, runners, guide bearings
		2	Guide vanes servo motors
		3	Governors
III	Generators	1	Stator
		2	Rotor, thrust and guide bearing

Chapter	*Title*	*Clause*	*Description*
		3	Excitation system
		4	AV Rs
		5	LA and terminal cubicle
IV	Generator transformer bus ducts		
V	Transformers	1	Main step up transformers
		2	Station and auxiliary transformers
VI	Control protection and annunciator system	1	Control, metering and relay panels and desk
		2	Annunciator panel
		3	Control cables and connection
VII	D C system	1	Batteries
		2	DC boards
VIII	Station and auxiliary power system	1	HT switch gear
		2	LT boards
		3	Power cables
IX	Grounding system		
X	Compressed air system of power house		
XI	Carbondioxide protection system		
XII	EHV switchyard	1	EHV circuit breakers
		2	Isolators
		3	Current transformer
		4	Potential transformers

Chapter	*Title*	*Clause*	*Description*
		5	Lightening arrestors
		6	Carriers and communication system
		7	Switch yard compressed air system
		8	Busbars and jumper connections including insulators
XIII	Power station lighting system		
XIV	Emergency electric supply system		
XV	Mulsifier protection system		

3.6 Flood Embankment — This part may have the following chapters and clauses :

Chapter	*Title*	*Clause*	*Description*
I	Premonsoon maintenance	1	Levelling of embankments top and slopes as per the design levels
		2	Keep the roads and ramps free of ruts, pockets etc
		3	Maintain the embankment to the design grade and section with rammed earth
		4	Refilling of leaks and animal burrows with good earth
		5	All repairs to masonry works should be carried out to avoid seepage along the plan of contact between the earth and masonry
		6	Maintenance of small grass and thick bushes should be given due attention
		7	Inspection of river course should be undertaken to formulate programme for anti-erosion works before flood season

Chapter	*Title*	*Clause*	*Description*
		8	Proposals for wetting of embankments during the monsoon should be carefully planned in advance
		9	Filling up of burrow pits on land side should be undertaken
		10	Proper filling of rat holes, deep raincuts etc
		11	Checking of operation of the gates of the sluices properly
		12	Stocking of important material required for maintenance
		13	To provide gauges to observe water levels
		14	To install wireless sets for communications
II	Maintenance during monsoon	1	Deployment of proper staff for patrolling during monsoon
		2	To detect boils and take immediate remedial measures
		3	To check seepage by providing sufficient cover over the saturation line
		4	To watch the starting of wave wash during the high wind and to take immediate remedial measures like placing of sand bags or earth to protect the top and slopes
		5	To detect the scour and take immediate preventive measures
		6	To watch the overtopping of embankment and take action to raise the bund
		7	If the road is acting as embankments, dowel bunds may be provided to avoid overtopping
		8	Settlement should be immediately detected and settled portion refilled with sand or fine earth

Chapter	*Title*	*Clause*	*Description*
		9	Breach in the embankment when detected should be inspected by the Executive Engineer and action taken to close by sand bags
		10	To observe the water level round the clock
		11	To watch and prevent the borrow areas on the river side developing into active channel

4. LAND ACQUISITION AND REHABILITATION

4.1 Land Acquisition and Rehabilitation — This part may have the following chapters and clauses :

Chapter	*Title*	*Clause*	*Description*
I	Land acquisition for works and that coming under submergence	1	Land up to which land to be acquired for submergence and construction works
		2	Statement showing villages submerged along with total area of the villages and the area to be acquired and also the percentage of the total area of the village
		3	Cost of acquiring land
		4	Statement of village-wise structures such as buildings, stables, temples, other religious buildings and wells. Actual cost paid for acquisition and basis for payment less value of usable material
		5	Compensation for standing crops village-wise
		6	Compensation for trees and forest areas
		7	Archaelogical monuments, if any
		8	Prospective mineral deposits if any

NOTE — The following charges are to be included under appropriate items mentioned above:

a) Rent for the use of the land,
b) Interest charges on the amount of awards for the period between taking over possession of the land and the award,
c) Solatium charges for compulsory acquisition,
d) Demarcation of land, and
e) Legal charges

Chapter	*Title*	*Clause*	*Description*
II	Rehabilitation	1	Relocation of communications like roads, railways, telegraph lines, transmission lines, etc
		2	Statement of persons displaced and their occupation village-wise
		3	Acquisition of lands for new village sites and allotment of plots to the villagers at suitable rates
		4	Making the acquired land fit for rehabilitation and providing facilities such as village roads, wells, school buildings, post offices, dispensaries, recreation facilities, places of worship, monuments and power supply
		5	Providing free transport for shifting household effects and livestocks
		6	Alternative means of employment for the oustees
		7	Grants-in-aid paid, if any

5. ALBUM OF DRAWINGS

5.1 This may be brought out in several volumes and should contain the following :

a) Main and typical drawings relating to all the features of the dam;

b) Main and typical drawings relating to all the features of the power plant and switchyard;

c) Main and typical drawings relating to all the features of construction plant at the dam site;

d) Main and typical drawing relating to layout to channels for irrigation, flood-control, navigation, water supply, etc with their headworks; and

e) Main and typical drawing relating to layout of power system, connections to grids, sub-stations, etc.

6. TECHNICAL REPORTS

6.1 These may be prepared for the following aspects :

a) Brochure on the project,
b) Drafting standard,
c) Construction of diversion tunnels/channel,
d) Coffer dam,
e) Foundation excavation,
f) Grouting operation,
g) Specification on pozzolana,
h) Specification of concrete,
j) Reinforcement standard,
k) Concrete operation and mass concreting,
m) Specification for formwork,
n) Specification for pneumatic applied mortar,
p) Specification for anchor bars,
q) Important construction aspect of power house,
r) Rules for operation of hydel channel,
s) Irrigation, flood control, navigation and water supply channels,
t) Instrumentations,
u) Design and other problems encountered during execution,
v) Comprehensive report on the geology and geotechnical investigation,
w) Delays, deviations and cost overalls, and
y) Appraisal of economic and financial aspects at the completion of project.

7. GET UP OF THE PUBLICATION

7.1 Keeping in view the vital importance of these publications, it is essential to get these bound, to distinguish the publications more easily, with different coloured wrappers.